US Army Corps of Engineers
Huntington District

DOVER DAM

Muskingum Basin, Ohio

Dam Safety Assurance Program
Final Evaluation Report and Environmental Impact Statement

June 2007

DOVER DAM

MUSKINGUM RIVER BASIN, OHIO

DAM SAFETY ASSURANCE PROGRAM EVALUATION REPORT

FINAL MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT

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EXECUTIVE SUMMARY

General

The Huntington District has completed a Dam Safety Assurance Program (DSAP) Draft Evaluation Report and Environmental Impact Statement for the Dover Dam, Muskingum Basin, Ohio. The report was prepared in accordance with ER 1110-2-1155 *Dam Safety Assurance Program* dated 12 Sepetmber 1997. Draft ER 1110-2-1156 *Safety of Dams-Policy and Procedure* dated 29 April 2003 was also consulted for guidance.

Dover Dam is located in Tuscarawas County on the Tuscarawas River approximately 3.5 miles northeast of Dover, OH. The dam was constructed by the Corps of Engineers and completed in 1937. It is a concrete gravity dam. It is a dry dam with a maximum flood control pool elevation of 916 feet above mean sea level. The dam is 820 feet long and 83 feet high with a drainage area of 1397 square miles. It has an uncontrolled spillway in the center channel. The outlet works are located at the base of the spillway section and has 18 gate-controlled sluices in sets of six at three different levels. The stilling basin is divided into three elevations, separated by walls, which correspond to the three levels of conduits or sluices.

Purpose and Need for Agency Action

Periodic inspections of the Dover Dam by the Corps have revealed significant dam safety concerns which have grown over the life of dam. The Corps has determined the dam cannot safely accommodate flooding from theoretical Probable Maximum Flood (PMF) events. The dam is also believed to be unstable against sliding under conditions below the PMF due to known faulting and uncertain foundation bedrock quality.

The objectives of this project is to develop the most cost effective, environmentally sound plan to upgrade Dover Dam to meet current hydrologic design standards and to address stability issues associated with inadequate bedrock foundation. The objectives also include protecting project facilities including the adjacent park area and Ohio Route 800.

Alternatives Evaluation

All reasonable alternatives were developed to address project objectives. These alternatives were further evaluated considering engineering, economic and environmental feasibility. The plan formulation was conducted in two phases, initial screening and selection of recommended alternative.

Specific formulation guidance for DSA projects is located in EC 1110-2-6061, "Safety of Dams – Policy and Procedures for interim guidance". This guidance states that, "recommended plans under the dam safety assurance program, except in certain circumstances, meet or exceed the Base Safety Condition (BSC)." The BSC is defined as the flood where no significant economic damages or probable loss of life is incurred from dam failure as compared to that of non-failure. For this project, the BSC evaluation indicated the probable loss of life and economic damages were always greater during dam failure for floods up to 100% of the PMF. Therefore, the 100% PMF is the BSC for this project. For the purposes of this study, the BSC was considered a minimum standard which all alternatives must achieve. No alternatives which accommodate levels below the BSC were considered for further evaluation beyond the initial screening.

Three alternatives, No Federal Action, Raise Dam, and Dam Overtop were retained for detailed consideration in the final screening. The table below summarizes economic and environmental considerations of each of these alternatives.

Summary Comparison of Final Alternatives

	No Action	Raise Dam	Dam Overtop
1. Plan Description	Without project condition/no dam modifications	This alternative would allow the dam to safely pass 100% of the PMF through raising the existing non-overflow sections with concrete parapet walls constructed on the existing dam. To address inadequate bedrock foundation and potential for sliding under PMF conditions, the project also includes installation of anchors in the spillway and stilling basin.	This alternative would allow the dam to safely pass 100% of the PMF through the modification of the existing non-overflow section of the dam to withstand overtopping. Like Alternative 1, anchoring is also included to address inadequate bedrock foundation.
2. Economic			
Project cost	$0	$105.7 M	$1141 M
Annual Cost	NA	$ 5.7 M	$6.2 M
Annual O&M	NA	$2 K	$2 K
Annual Benefits	$0	$15.9 M	$15.9 M
Net Benefits		$10.2 M	$9.7M
F. BCR		2.8	2.6
3. Environmental			
Terrestrial resources	No impact	Minor impacts from loss of about 2.6 acres riparian forest.	Minor impacts from loss of about 2.8 acres riparian forest.
Terrestrial resources	No Impact	Minor impacts from loss of about 2.6 acres riparian forest.	Minor impacts from loss of about 2.8 acres riparian forest.
Aquatic Resources	No impact	Minor impacts during construction.	Minor impacts during construction.
Socioeconomic	No impact	Minor impacts during construction.	Minor impacts during construction.
Recreation Resources	No impact	Temporary closure of recreational areas during construction and permanent obstruction of upstream viewing from abutment decks.	Temporary closure of recreational areas during construction.
Traffic & Transportation	No impact	Minor impacts during construction.	Minor impacts during construction.
Aesthetics	No impact	Adverse effect from the construction of walls across Route 800 and on abutment decks.	Greater adverse effect from the construction of walls across Route 800 and construction of concrete sloped spillway and placement of stone slope protection on downstream abutment face.
Cultural Resources	No impact	Potential for adverse effect to cultural integrity of dam.	Greater potential for adverse effect to cultural integrity of dam.

HTRW	No impact	Some potential to encounter HTRW	Greater potential to encounter HTRW concerns in the abutment areas.
Air Quality	No impact	Minor and temporary decrease in air quality due to construction activities.	Minor and temporary decrease in air quality due to construction activities.
Noise	No impact	Minor and temporary increase in noise due to construction activities.	Minor and temporary increase in noise due to construction activities.

Recommended plan

The final screening and selection of the recommended plan is based on an assessment of the alternatives' ability to meet project objectives, economic impacts (costs and benefits), and environmental impacts. The **Raise Dam** alternative was chosen as the recommended plan because it more reliably meets project objectives, minimizes costs, and has the least adverse environmental effects.

This alternative would allow the dam to safely pass 100% of the PMF through raising the existing non-overflow sections with concrete parapet walls constructed on the existing dam. I-walls sections would also be necessary to continue the parapet walls to their termination at high ground. Both parapet walls would be constructed on the upstream side of their respective non-overflow portions of the existing dam. The parapet wall and I-wall combination on the left abutment of the dam would be approximately 240 linear ft. and 140 linear ft. respectively. The proposed parapet wall on the right abutment of the dam would be approximately 130 linear feet. This parapet wall would then adjoin a 170 linear ft. I-wall which would adjoin a 25 ft. gate closure over Ohio Route 800. Average wall height for parapet wall and I-walls would be 8 feet. To address inadequate bedrock foundation and potential for sliding under PMF conditions, the project also includes adding 27 anchors (3 anchors per monolith) to the spillway section of the dam and approximately 130 anchors to the stilling basin. To preclude erosion from undermining the existing stilling basin and dam during flood events which would overtop the spillway, construction of a concrete cutoff wall at the end of the existing stilling basin is included with this alternative.

DAM SAFETY ASSURANCE PROGRAM
EVALUATION REPORT AND
ENVIRONMENTAL IMPACT STATEMENT
DOVER DAM, OH
TUSCARAWAS RIVER

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1 General

1.1 Project Authorization

The original system of 14 reservoir projects in the Muskingum River Basin, which included Dover Dam, was constructed in cooperation with the Muskingum Watershed Conservancy District (MWCD). The MWCD, a public corporation, was created on 3 June 1933, for the purpose of developing a plan for flood control, water conservation and water use in the Muskingum River Basin. A general plan was prepared and application for approval of the project and a request for financial cooperation were filed with the Federal Emergency Administration of Public Works in August 1933. The Public Works Administration approved the project in December 1933 and allocated funds to the Corps of Engineers in financing the construction of the project. The Corps of Engineers initiated investigations following execution of a contract between the United States of America and the MWCD on 29 March 1934, also known as "the 1934 Agreement". The official plan was prepared by the Corps of Engineers and was approved by the MWCD on 19 November 1934. Section 4 of the Flood Control Act of 1939, 53 Stat. 1414, made the U.S. Army Corps of Engineers responsible for the operation and maintenance of the Dover Dam. Construction of the Dover Dam was completed on 29 November 1937 at a cost of $7,755,300, which included study costs.

The Dam Safety Assurance Program provides for modification of completed Corps of Engineers dam projects that are potential safety hazards in light of present-day engineering standards and criteria. The program is intended to facilitate upgrading of those project features that have hydrologic, seismic and/or state of the art design and construction deficiencies related to dam safety to enable the project to function safely and effectively.

1.2 Purpose and Need for Agency Action

Periodic inspections of the Dover Dam by the Corps have revealed significant dam safety concerns which have grown over the life of dam. The Corps has determined the dam cannot safely accommodate flooding from theoretical Probable Maximum Flood (PMF) events. The dam is also believed to be unstable against sliding under conditions below the PMF due to known faulting and uncertain foundation bedrock quality.

Recently, the Corps has classified many of its dams with respect to dam safety. The classification was performed as an initial screening for Corps projects with the intent of assisting decision makers to allocate limited resources to those projects which have the greatest risk. The classification is divided into five dam safety action classes I to V. A project within class I indicates the progressive failure is confirmed to be taking place under normal load and is almost certain to fail under normal load within a few years without immediate action. Conversely, class V indicates the dam is adequately safe. The Dover Dam was classified as class II. This classification indicates that the dam is expected to fail or an active failure is expected to be initiated as the result of an event (e.g. flood or earthquake) that is reasonably expected to occur prior to remediation although dam safety issues may require confirmation. Currently, operation of the project has been modified from the original operation plan to curtail risk from a pool retention which would present an unsafe condition.

The objectives of this project is to develop the most cost effective, environmentally sound plan to upgrade Dover Dam to meet current hydrologic design standards and to address stability issues associated with inadequate bedrock foundation. The objectives also include protecting project facilities including the adjacent park area and Ohio Route 800.

1.3 **Existing Project Description**

Dover Dam is located in Tuscarawas County on the Tuscarawas River approximately 3.5 miles northeast of Dover, OH. The dam was constructed by the Corps of Engineers and completed in 1937. It is a concrete gravity dam with rock and earth fill. It is a dry dam with a maximum flood control pool elevation of 916 feet above mean sea level. The dam is 820 feet long and 69 feet high with a drainage area of 1397 square miles. It has an uncontrolled spillway in the center channel. The outlet works are located at the base of the spillway section and has 18 gate-controlled sluices in sets of six at three different levels. The stilling basin is divided into three elevations, separated by walls, which correspond to the three levels of conduits or sluices (USACE 2004). The Huntington District has fee title to 146.41 acres.

The Dover project also includes levees located remotely upstream from the dam at Zoar and Somerdale, as well as three industrial levees to protect the Corundite Refractory at Zoar, the Fairfield Brick Company at Zoarville, and the Norton Chemicals Company at Mineral City. Evaluation of these structures is not within the scope of this report.

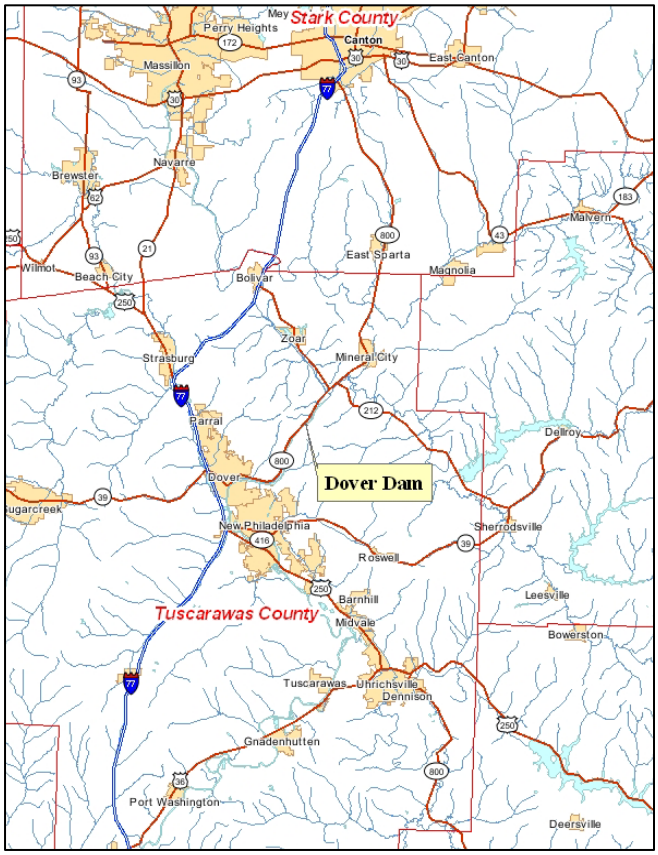

Figure 1. Vicinity map depicting the location of Dover Dam

1.4 **History of Maintenance and Rehabilitation or Modification**

Below is a list of remedial measures and major maintenance activities for Dover Dam as reported in the most recent Periodic Inspection Report No. 8 dated June 2006. Excluded from this list are items relating to the associated levees which are not covered by this report.

Inspection of the stilling basin (sounded)	1981
Inspection of the stilling basin (diver inspection)	1987
Inspection of the stilling basin (diver inspection)	1996
Inspection of the stilling basin (diver inspection)	2006
Installation of alignment and settlement points on dam	1988
Replaced maintenance bulkhead guide rails, repaired stud bolts in gate guides	1988
Placed rip rap along toe of right downstream abutment of dam	1992
Remove silt (dredging) & debris from upstream side of dam	1992 - ongoing
Installed remote control system at dam for Gates 1-6	1992
Installed hydraulic filter system for gate operators at dam	1998
Repaired concrete (cosmetic) on dam and installation of drift removal pad.	2000
Repaired concrete of basin walls and top of dam	2003
Repair basin walls / crack in gallery	2005
Emergency generator for area office	2003
Installed new 24” CPP culvert, with grouted riprap inlet and outlet in left abutment access road	
Cleaned existing foundation drains with pressure water	2005
Patched concrete scaling on steps and curbs	2005

1.5 **Current Condition of Dam**

The latest inspection of Dover Dam, which occurred in June of 2006 under the Periodic Inspection Program, concluded that the project is well maintained with significant ongoing concerns such as stability and hydrologic deficiencies which are discussed in detail in this report.

1.6 **Environmental Setting**

This section describes existing baseline conditions in the Tuscarawas River Basin and Tuscarawas County, with emphasis on those resources potentially impacted by the Proposed Action and alternatives. Within this section, “the project study area” generally refers to the area encompassed within the construction work limits of the project including those highway areas that may be used for construction traffic.

1.6.1 General.

The Dover Dam resides within the Muskingum River Basin. This basin is located in east central Ohio and is the largest individual drainage basin in the state, with a drainage area of 8,051 square miles. This represents about one-fifth of the state's total area. At Coshocton, Ohio, in the center of the basin, the Muskingum River is formed by the confluence of the Walhonding and the Tuscarawas Rivers. From there, the Muskingum flows 112 miles in an irregular southerly course to the Ohio River at Marietta, Ohio. The 16 operating projects of the Muskingum are situated on streams of the Muskingum and its four principle tributaries: the Tuscarawas, Walhonding, Licking Rivers and Wills Creek.

The Dover Dam project is located on the Tuscarawas River, in Tuscarawas County, approximately 3.5 miles northeast of Dover, OH. The dam is approximately 174 miles above the mouth of the confluence with the Muskingum.

1.6.2 Climate.

Like the rest of Ohio, the climate of the Muskingum basin is continental, with pronounced seasonal changes marked by wide annual and day-to-day temperature ranges. Mean maximum temperatures in January are around 35°F and around 85°F during July, with occasional days above 90ºF. Precipitation averages 37-40 inches per year and is fairly evenly distributed across the basin. Annual snowfall ranges from 30 inches in the south to 40-50 inches in the north, and the average frost-free growing season through most of the region is 150-160 days.

1.6.3 Physiography, geology and soils.

The Muskingum River Basin lies within three physiographic sections. The western section is in the Till Plains section of the Central Lowlands Province. A narrow transitional zone between the Till Plains and unglaciated Allegheny Plateau falls in the Low Plateau section, which is a mature glaciated plateau with moderate relief. Most of the basin lies in the Kanawha section of the Appalachain Plateaus Province, which is a mature plateau of moderate to strong relief. The northern and western parts of the basin were affected by at least two continental glaciers and are composites of various types of glacial deposits. A summary of existing geology and soils is provided below. An in depth analysis of local geology and soils is provided in Appendix C.

The bedrock of the Muskingum basin is primarily of sedimentary origin, deriving from the Mississippian and Pennsylvanian systems. About 3.2 km (2 miles) upstream from the dam site, the Tuscarawas River leaves a broad, deeply filled pre-glacial valley and flows for 9.6 km (6 miles) through a narrow steep-walled gorge of post-glacial origin. The river throughout most of the length of the gorge flows on bedrock or on a very shallow cover of alluvial sand and gravel over bedrock. Bedrock consists of nearly horizontal beds of shale, siltstone, sandstone, limestone and coal. These beds are part of the Pottsville Group of the Lower Pennsylvanian System. The Lower Mercer limestone forms most of the foundation of the dam, with shale, sandstone, and coal over- and underlying the limestone. Below the limestone is shale into which several of the monoliths are keyed.

Within east central and southeastern Ohio, a region that encompasses the Muskingum Basin, at least 30 different soil associations have been described. These soils formed from underlying bedrock of the Mississippian, Pennsylvanian, and Permian ages. These are interbedded, resulting in mixed parent soil materials, and the end result is further affected by the downslope movement of weathered rock material. Two common soil associations in this region, Gilpin and Upshur, developed under mostly oak forest vegetation and, as a consequence, have argillic horizons; both contain soils that are well-drained and found on ridgetops and side slopes with up to 70 percent slope. Gilpin soils are generally only 50.8 to 101.6 cm (20 to 40 in) deep to bedrock, while Upshur are generally >101.6 40 in deep to the underlying parent material of soft shale bedrock.

1.6.4 Terrestrial Resources

The predominant forest type in the Muskingum basin is the Oak-Hickory with the northern and western portions of the basin with the Maple-Beech-Birch type (See Figure 2). The dominant trees of the forest canopy are beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*); sweet buckeye (*Aesculus octandra*); white oak (*Quercus alba*); and hemlock (*Tsuga Canadensi).* The most diverse areas of the mixed mesophytic forest are in the low lying regions along the rivers and streams in riparian zones.

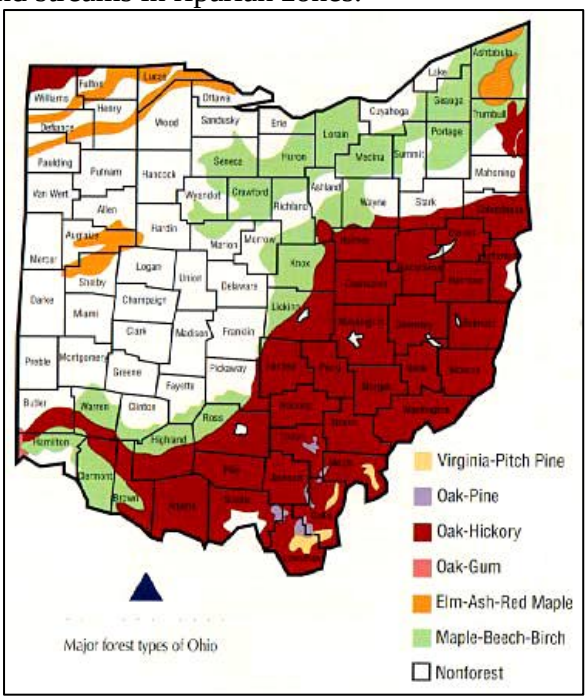

Figure 2. Major Forest types in Ohio

Much of the existing forest, whether old growth or regrowth forests, is still distributed in a highly fragmented mosaic throughout the basin, broken by agriculture, residential and commercial area growth, roads, power lines, towns, and other forms of development.

Terrestrial resources in the vicinity of Dover Dam are of moderate to high quality. Field surveys reveal a well developed, relatively unfragmented riparian corridor in the project area. Maintained areas associated with dam facilities and two narrow, abandoned railroad beds situated parallel to the Tuscarawas River are the main interruptions in the otherwise well developed, continuous riparian forest. Moreover, several forested wetlands were identified in these riparian areas. A species list characterizing the existing vegetation found is included as an attachment to the Fish and Wildlife Service's Planning Aid Letter in Appendix H.

1.6.5 Wildlife & Endangered Species

There are 393 land vertebrate species present in the Muskingum basin; 33 are amphibians, 37 are reptiles, 267 are birds, and 56 are mammals (USACE 1977). The project also is within the range of three federally listed threatened and endangered species.

The proposed project lies within the range of the Indiana bat (*Myotis sodalis*), a Federally-listed endangered species. Since first listed as endangered in 1967, its population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat; these include the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines.

Summer habitat requirements for the species are not well defined, but the following are considered important:

(1) dead or live trees and snags with peeling or exfoliating bark, split tree trunks and/or branches, or cavities, which may be used as maternity roost areas;
(2) live trees (such as shagbark hickory and oaks) which have exfoliating bark;
(3) stream corridors, riparian areas, and upland woodlots which provide forage sites.

A cursory onsite survey performed by biologist from the U.S. Fish and Wildlife Service (USFWS) revealed very little, if any, potential Indiana bat habitat within the riparian areas along the right bank within the upstream and downstream riparian areas (see USFWS Planning Aid Letter in Appendix H).

The project area lies within the range of the bald eagle (*Haliaeetus leucocephalus)*, a Federally-listed threatened species. Coordination with the Ohio Department of Natural Resources (ODNR) determined that the nearest known nest is approximately 10 miles from the project area.

The proposed project lies within the range of the clubshell mussel (*Pleurobema clava*), a Federally-listed endangered species. The clubshell inhabits areas with sand or gravel substrate and also prefers areas with riffles and runs.

1.6.6 Aquatic resources

1.6.6.1 Streams

The Tuscarawas River study area is located in the Erie-Ontario Lake Plain and Western Allegheny Plateau ecoregions and is currently assigned the Warmwater Habitat aquatic life use by the Ohio Environmental Protection Agency (OEPA). The stream has a drainage area of 2,590 square miles. Stream morphology of the Tuscarawas River mainstem is primarily free-flowing and consists of pools interspersed with well-developed riffle and run habitats. Bottom substrates are predominated by cobble, gravel and sand. Two sections of the river are impounded: one by a low-head dam in Zoar and the other by Dover Dam.

Evaluation of existing field data collected by the OEPA indicates that stream and riparian habitat in the Tuscarawas River near Dover Dam is of good quality. Qualitative Habitat Evaluation Index (QHEI) is a metric commonly used in Ohio to determine the quality of physical habitat important for aquatic communities. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the WWH biological criteria. Scores greater than 75 typify habitat conditions which have the ability to support exceptional warmwater faunas. QHEI scores collected near the Dover Dam have ranged from 70 to 80 for the past 10 years. These scores indicate that stream and riparian habitat conditions in these areas are well capable of supporting warm water habitat stream communities. A complete record of QHEI data collected near the Dover Dam can be found as an attachment to the Fish and Wildlife Service's Planning Aid Letter in Appendix H.

Species composition and community structure of macroinvertebrates and fish also provide insight to the suitability of the physical and chemical properties of the stream. The most commonly used metrics for invertebrates and fish in Ohio are the invertebrate community indexes (ICI) and the index of biological integrity (IBI). These metrics compare several measures of the quality of the fish and benthics relative to an undisturbed reference reach. The ICI and IBI are numerical scores ranging from 12 (poor) to 60 (high quality).

ICI scores for the survey sites near Dover Dam range from 42 to 46 for the past 10 years. IBI scored for survey sites near Dover Dam show significant improvement over the 10 year period being as low as 14 in 1995 to as high as 42 in 2005. This data indicates that the biological conditions in the Tuscarawas River mainstem are presently of good to very good quality. More recent data compared to past data also indicates a general trend of improving biological condition in the past decade. A complete set of ICI and IBI data for the past 10 years can be found as an attachment to the Fish and Wildlife Service's Planning Aid Letter in Appendix H..

1.6.6.2 Wetlands

Field surveys revealed several acres of forested wetlands which are situated in the riparian areas along the left descending bank upstream and downstream of the dam.

1.6.7 Socioeconomic resources

Tuscarawas County, with a population of 90,914, is home to approximately 38,114 households. Generally, the population of Tuscarawas County is growing at a rate of 0.8% annually. Tuscarawas County's median age of 37.9 years in 2000 is comparable to surrounding counties; however, it is slightly higher than the state median of 36.2 years and the U.S. median of 35.4.

With respect to race, Tuscarawas County is a relatively homogenous area. More than 97 percent of the population is recorded as 'White' in the 2000 U.S. Censuses. A summary of population characteristics for Tuscarawas county are shown in **Table 1** below.

Table 1. Population Characteristics, Tuscarawas County	
Characteristic	**2000**
Population	91,944
Under 18 years	23.7%
65 years and older	15.3%
Median Age	37.9
Sex	
Male	48.7%
Female	51.3 %
Race	
One Race	99.3%
White	97.9 %
Black or African American	0.7 %
American Indian or Alaska Native	0.2 %
Asian	0.2 %
Native Hawaiian or Other Pacific Islander	0.0 %
Other	0.2 %
Two or More Races	0.7 %
Hispanic or Latino Origin	
Hispanic or Latino of Any Race	0.7 %
Not Hispanic or Latino	99.3 %
U.S. Census Bureau, 2000 U.S. Census	

There are 25,396 families within Tuscarawas County, of those 7.2% are below the poverty level. This is slightly below the poverty level of the state (7.8%) and well below the U.S. poverty level of 9.2%.

1.6.8 Recreation

Recreational activities within and in the vicinity of Tuscarawas County are numerous. Recreation opportunities including hunting, fishing, bird watching, camping, hiking and boating are available at 10 of the lakes managed by the Muskingum Watershed Conservancy District (MWCD). The MWCD has 54,000 acres of land and water designated for recreation and conservation activities. Atwood Lake, Beach City, Clendening, Leesville, and Tappan Lakes are all within easy access of visitors to Tuscarawas County.

Recreational opportunities at the Dover Dam facility are somewhat limited. These opportunities include fishing and picnicking at the public use area. Each year, the dam hosts an annual event, Great Dover Dam Day, in the first weekend in May. This event is conducted in coordination with the Camp Tuscazoar Foundation, a local non-profit foundation which operates and maintains the nearby Camp Tuscazoar for use by the scouts, church groups, schools and other community youth organizations. The Great Dover Dam Day consists of numerous dam tours which are open to both the Boy Scouts and the general public. Detailed recreation data for the Dover Dam facilities, including number of visits, visitor hours and visitor days, is included in Appendix H.

Camp Tuscazoar (previously mentioned), is located approximately 1 mile northeast of the Dam on the left descending bank of the Tuscarawas River. This privately owned and operated camp is comprised of approximately 500 acres of forest land and deep ravines. The camp is open all year around, holds numerous recreational events and provides camping, hiking and fishing facilities.

Recreation opportunities near the Dover Dam, but not necessarily on government grounds include biking on state roads, and hiking around the dam on nearby the numerous trails and abandoned railroad beds. A trailhead to a large trail system, the Ohio & Erie Canal Trail, resides just north of the dam near the intersection of Route 212 and Route 800. A portion of smaller trail, the Zoarville Trail, utilizes the abandoned rail bed on the left bank of the river. This trail is maintained and operated by the Camp Tuscazoar Foundation. This trailhead at the southernmost point is located in the Village of Schoenbrunn in New Philadelphia, Ohio; its northernmost trailhead is at Fort Laurens in Bolivar, Ohio. The 20-mile trail provides hikers with scenic views and stops at various points of interest and historical sites including the Dover Dam. Near the Dover Dam, the trail utilizes the former railroad right of way on the left descending bank.

1.6.9 Traffic

State Route 800 lies within the construction work limits of the project. Average Daily Traffic on this route is 5169. This Route is classified by the Ohio Department of Transportation as a Rural Major Collector. Routes of this functional classification generally provide intracounty rather than statewide travel and serve more moderate travel speeds than arterial routes.

1.6.10 Visual and Aesthetic Resources

Visual resources are defined as the natural and manufactured features that comprise the aesthetic qualities of an area. These features form the overall impression that an observer receives of an area or of its landscape character. Landforms, water surfaces, vegetation, and built features are considered characteristic of an area if they are inherent to the structure and function of a landscape.

The Tuscarawas River is not recognized in the National Wild and Scenic River System. However, aesthetic and scenic resources in the Tuscarawas Basin are numerous. Scenic viewsheds in the basin include natural forestland, wildlife habitat and cultural/historic points of interest.

A large segment of Route 800, including that which is adjacent to the project area, is a portion of the Canal Way Scenic Byway. This Byway is one of Ohio's nationally recognized scenic byways. This byway approximates the path of the historic Ohio and Erie Canal, and provides a connection between many natural, cultural and recreational attractions found between Cleveland and Dover/New Philadelphia. The Dover Dam is considered a point of interest along this byway.

The Dover Dam itself is considered to be a significant aesthetic resource for the area. It is also one of only a small number of large pre-World War II concrete gravity dams in Ohio that have a high level of integrity, and is a good example of the application of the Art Deco architectural style to a 1930s public works project. Moreover, it is eligible for listing in the National Register of Historic Places (Refer to section 1.6.11 entitled "Cultural Resources).

1.6.11 Cultural Resources

An initial archaeological survey was completed on land owned by the Huntington District at Atwood, Beach City Lake, Bolivar Dam, Charles Mill Lake, Clendening Lake, Dillon Lake, Dover Dam, Mohawk Dam, Mohicanville Dam, Pleasant Hill Lake, and Senecaville Lake in 1982 (Brown 1982). The data produced from this survey and other surveys conducted within the basin was compiled and documented within the Corps Historic Properties Management Plan for the Muskingum Basin. Three databases maintained by the Ohio Historic Preservation Office were used for this inventory: the Ohio Archaeological Inventory (OAI), the Ohio Historic Inventory (OHI), and the National Register of Historic Properties (NRHP). The inventory recorded several Archaeological and Historic Sites within the boundaries of Federal property at Dover Dam.

The Corps contracted Hardlines Design Company to perform a National Register of Historic Places (NRHP) Inventory and Evaluation of Dover Dam. In this study, the Dover Dam property was evaluated, physically and through intensive literary research, for its eligibility for inclusion in the NRHP. To be eligible for the NRHP, a property must possess integrity of location, design, setting, materials, workmanship, feeling, and association, and the property must meet one of the four criteria listed below:

A) Be associated with events that have made significant contributions to the broad pattern of history
B) Be associated with the lives of persons significant in our past
C) Embody the distinctive characteristics of type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
D) Yield, or be likely to yield, information important in prehistory or history.

The evaluation concluded that the dam was eligible for listing in the National NRHP under Criteria A and C. Under Criterion A, the dam is associated with New Deal public works programs, the ambitious federal flood control programs of the 1930s-1940s, and the history of the Muskingum Watershed Conservancy District. Under Criterion C, the dam is a good large-scale example of a 1930s-1940s poured concrete gravity dam, which is a major dam construction type. There are relatively few dams of this type, vintage, and scale in Ohio that survive with such a high level of integrity. The aesthetic features of the dam also make it a good example of the Art Deco style.

The full text of this Evaluation is included in Appendix H.

1.6.12 Hazardous, Toxic, and Radioactive Wastes

A Phase I Hazardous, Toxic, and Radioactive Waste (HTRW) Environmental Site Assessment (ESA) was conducted on the proposed Contract Work Limits (CWL) of the Dover Dam Safety Assurance (DSA) Project. The purpose of this Phase I HTRW ESA is to identify environmental conditions and to identify the potential presence of HTRW contamination located in the project's CWL. The investigation was performed in accordance with ASTM E-1527-00 and 1528-00 Standards, U.S. Army Corps of Engineers (USACE) HTRW policies and Corps of Engineers Huntington District ISO 9001 requirements. A copy of the final Phase I HTRW report is included in Appendix G.

Based on the research and site visit conducted as part of this ESA there are several environmental and/or HTRW concerns that may impact the proposed activities on the property. These concerns are summarized below:

- Possible soil contamination in the dredge material placement areas and surrounding soils located on the left and right descending banks upstream from Dover Dam.
- Possible river sediment contamination in the proposed construction area due to the Ashland Oil spill in 1995.
- Possible petroleum contamination discovered during 2004 geotechnical drilling program located on the right descending bank just downstream from Dover Dam.
- Though not considered a hazardous waste, the railroad ties in and around the downstream haul route would require to Toxicity Characteristic Leaching Procedure (TCLP) analysis prior to disposal at the appropriate facility.
- Due to the vault toilets being located within the CWL and the Dover Dam day-use area, samples for fecal coliform should be taken to ensure worker safety in the event of excavation near the leach field for these toilets.

1.6.13 Air Quality

The ambient air quality in a region can be characterized in terms of whether it complies with the primary and secondary national standards. The USEPA is required to set air quality standards for pollutants considered harmful to public health and welfare. Primary NAAQS set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, and prevention of damage to animals, crops, vegetation, and buildings (USEPA 1999a, b). These standards have been established for the following six principal pollutants, called criteria pollutants (as listed under Section 108 of the CAA):

- Carbon monoxide (CO);
- Lead (Pb);
- Nitrogen dioxide (NO_2);
- Ozone (O_3);
- Particulate matter, classified by size as follows:
- An aerodynamic size less than or equal to 10 micrometers (PM_{10});

- An aerodynamic size less than or equal to 2.5 micrometers ($PM_{2.5}$); and
- Sulfur dioxide (SO_2).

Criteria pollutants, when they exceed the NAAQS, can be detrimental to public health and the environment and can cause property damage. The NAAQS for each criteria pollutant are shown in **Table 2** (USEPA 1999b).

Table 2. National Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Standard	
		Value	Type
National and State Standards			
Carbon monoxide (CO)	1 hour	35 ppm	Primary
	8 hours	9 ppm	Primary
Lead (Pb)	30 days	-	-
	1 quarter	1.5 $\mu g/m^3$	Primary & Secondary
Nitrogen dioxide (NO_2)	1 hour	-	-
	1 year	0.053 ppm	Primary & Secondary
Ozone (O_3)	1 hour	0.12 ppm	Primary & Secondary
	8 hours	0.08 ppm	Primary & Secondary
Particulate matter ≤ 10 μm diameter (PM_{10})*	24 hours	150 $\mu g/m^3$	Primary & Secondary
	1 year	50 $\mu g/m^3$	Primary & Secondary
Particulate matter ≤ 2.5 μm diameter ($PM_{2.5}$)*	24 hours	65 $\mu g/m^3$	Primary & Secondary
	1 year	15 $\mu g/m^3$	Primary & Secondary
Sulfur dioxide (SO_2)	3 hours	0.5 ppm	Secondary
	24 hours	0.14 ppm	Primary
	1 year	0.03 ppm	Primary

ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter
N/A – Project Ambient Air Quality Standards (PAAQS) are not assigned a designation of primary or secondary.
Source: USEPA, 1999b

The General Conformity Provision of the CAA of 1970 (42 USC 7401 et. seq.; 40 CFR Parts 50-87) Section 176(c), including the USEPA's implementation mechanism, the General Conformity Rule (40 CFR Part 51, Subpart W), requires Federal agencies to prepare written Conformity Determinations for Federal actions in or affecting NAAQS non-attainment areas or maintenance areas. Tuscarawas County is designated as "In Attainment" for all NAAQS criteria pollutants. Therefore, a written General Conformity Determination is not required for this Proposed Action.

1.6.14 Noise

Noise sources in the project area are variable, and are a combination of natural and man-made sounds. Sources of environmental noise may include, but are not limited to: traffic from major roadways and bridges; businesses and industries; trains; athletic events; construction events,

such as home-building or repair; roadway repair; and wind, animals (such as barking dogs) and other natural noises. Sensitive noise receptors are considered to be residences, hospitals, churches, schools, parks, and other locations where excessive noise exposure could adversely impact daily activities, health, or welfare. The closest receptors to the proposed construction area are more than ¼ mile away. However, several residences are located near areas along proposed haul routes.

1.7 **Project Use**

The primary authorized project purpose of Dover Dam is flood control. The dam is operated as a dry dam meaning no permanent pool is maintained at the project. There is also some recreational use on the downstream right bank which as previously described in Section 1.6.8.

1.8 **Consequences of No Dam Safety Modifications (No Action)**

As previously mentioned, a recent screening level assessment has indicated that the Dover Dam is in Dam Safety Action Class II. This classification indicates that the dam is expected to fail or an active failure is expected to be initiated as the result of an event (e.g. flood or earthquake) that is reasonably expected to occur prior to remediation although dam safety issues may require confirmation. If no modifications are made to address the hydrologic deficiency, the existing spillway would not be able to safely pass the design flood, the Probable Maximum Flood (PMF). Overtopping and failure of the dam would likely occur during a PMF storm event. Also, the dam does not meet current design standards related to stability and sliding as further described in Section 2.1. If No Action is taken by the government to address these deficiencies, the risks associated with dam failure would persist.

1.8.1 Dam Failure Analysis

The HEC-RAS computer model is considered to provide state-of-the-art analysis for unsteady flow conditions. The behavior of a large flood event through a system of streams and rivers is unsteady in nature. HEC-RAS simulates one-dimensional unsteady flow through a full network of open channels. The HEC-RAS computer model provides a state-of-the-art technique for determining a variety of characteristics of a flood wave, most notably flood wave travel times, velocities and flood wave depths that occur "with" and "without" dam failure. Therefore, the HEC-RAS computer program is the key to modeling the flood wave as it travels through the streams and rivers below Dover Dam. The failure parameters were determined based on past studies. The time for failure was 0.01 hours and it was assumed that the spillway section would be the monoliths that would fail. With the spillway monoliths removed the breach was 270 feet long and the toe of the breach was at elevation of 867.0. This breach condition was the same for each failure condition. For a detailed description of dam failure analysis, refer to Appendix C.

1.8.2 Economic Consequences

The economic losses that would occur with dam failure include damage resulting from inundation to residential, commercial, industrial and public properties and their contents in addition to farms and cropland.

The results of FDA modeling for the Tuscarawas River indicate that 12,430 structures in the study area are expected to sustain damage during failure of the dam under PMF conditions. Residential structures in the PMF flood plain total 11,154 and 1,276 are commercial. Numbers of structures and depths of flooding for properties in the study area are presented by county and damage category in Appendix I.

1.8.3 Population at Risk

Population at risk (PAR) is the number of people occupying the dam failure floodplain prior to the issuance of any warning. It is recognized that PAR varies throughout the day and also by season. PAR includes permanent and transient population. The permanent population is made up of the residents of the affected area. The transient population is made up of workers coming into the affected area to work. Estimates of the permanent PAR were made by deriving the average number of people per household for the counties in the study area from 2000 census data and multiplying these by the number of residences in each with damage potential. Total population at risk is estimated to be a total of 70,872; 25,162 in the high severity flood zone and 45,710 in the medium severity flood zone.

1.8.4 Potential for Loss of Life

Population at risk estimates are utilized in making estimates of loss of life resulting from a failure of the dam. A flood severity-based methodology presented in *A Procedure for Estimating Loss of Life Caused by Dam Failure*, by Wayne Graham, was employed in the estimate of potential loss of life for this study. Guidelines provided in the report to differentiate between high, medium and low flood severity were followed in this evaluation. The failure of Dover Dam would result in high severity flooding along the Tuscarawas River mainstem. Medium severity flooding would occur on the tributaries of the Tuscarawas and continue on Muskingum River mainstem and its tributaries. Fatality rates for flood zones applied to PAR provided the estimate of potential loss of life caused by a failure of the dam. The estimate of the probable loss of life in this situation is 49, with a range from 49 to 1000. It should be noted that loss of life estimates are extremely uncertain. There is no way to predict the actual impact to human life from a dam breach. The estimation of potential loss of life for this analysis is not intended to place a value on human life. This analysis is presented solely to illustrate the potentially catastrophic nature of a failure of the Dover Dam. For detailed description of the loss of life evaluation refer to Appendix C, Tab I.

2 Dover Dam Safety Assurance Evaluation

2.1 **Type of Problem**

2.1.1 Hydrologic Deficiency

Computational hydraulic modeling of the spillway determined that the existing spillway at Dover Dam could pass approximately 73% of the PMF before the non-overflow sections of the dam

would overtop. If the non-overflow section were to overtop the flows likely would rapidly erode the downstream embankments causing instability of the dam.

2.1.2 Seismic Deficiency

A cursory review of the dam with respect to current seismic criteria shows that the dam should safely withstand the maximum design earthquake. Dover Dam is in a low seismic hazard zone. Coupled with the fact this is a dry dam with a coincident pool of normal run of river, a seismic load case would not control the design.

2.1.3 State of the Art

Dover Dam was designed and constructed in the 1930's using some of the most modern techniques of the time and leading experts in dam design and construction. Among these was one of the first uses of foundation drains to relieve uplift pressures. However, it is now known that these drains were not designed or constructed in the most efficient manner. There have also been major advances in the calculation of these uplift forces.

Another major change in how Dover Dam is analyzed is in the application of rock mechanics and sliding stability calculations. Investigations and analyses utilizing modern techniques show that Dover Dam does not meet current criteria for sliding factors of safety.

2.2 **Extent of Deviation**

Hydrologic modeling showed that the PMF would overtop the non-overflow sections of the dam by as much as six and one-half feet. Without erosion control features downstream of the dam, which do not exist, this condition does not meet current design and construction criteria.

As part of this study an Imminent Failure Flood (IFF) curve was developed. A plot of curves identifying pool combinations that yield factors of safety of 1.0 (IFF), 1.1, and 1.2 is shown in Appendix C, Tab IV. All of these pool elevations would fall under unusual loading conditions (return periods greater than 10 years and up to 300 years) for which current criteria calls for a sliding factor of safety of 1.5. As seen on the graph, the pool of record yielded a factor of safety well below what is required. The analysis used to generate this curve contains a reasonable amount of conservatism due to the number of unknowns, the critical nature of the analysis, and the severe consequences of a dam failure. Details of this analysis are included in Appendix C.

2.3 **Average Annual Benefits**

The average of the annual benefit provided by the project for years 1937-2006 is $14,955,567 in FY 2007 dollars. These are based on aggregated stage-damage and benefit data developed by the original study for the project. The data has been adjusted in order to make appropriate estimates where current stream gage stations are located and are indexed to current price levels each year. The total flood damages prevented by the project in FY 2007 dollars for years 1937-2006 are approximately $1,046,889,674.

2.4 **Alternatives Evaluation**

All reasonable alternatives were developed to address project objectives described in the purpose and need. These alternatives were further evaluated considering engineering, economic and environmental feasibility. The plan formulation was conducted in two phases, initial screening and selection of recommended alternative.

Specific formulation guidance for DSA projects is located in EC 1110-2-6061, "Safety of Dams – Policy and Procedures". This guidance states that, "recommended plans under the dam safety assurance program, except in certain circumstances, meet or exceed the Base Safety Condition (BSC)." The BSC is defined as the flood where no significant economic damages or probable loss of life is incurred from dam failure as compared to that of non-failure. For this project, the BSC evaluation indicated the probable loss of life and economic damages were always greater during dam failure for floods up to 100% of the PMF. Therefore, the 100% PMF is the BSC for this project. The BSC analysis for the Dover Dam is described in detail in Appendix I. For the purposes of this study, the BSC was considered a minimum standard which all alternatives must achieve. No alternatives which accommodate levels below the BSC were considered for further evaluation beyond the initial screening. The initial alternatives in Section 2.5.1 (below) were considered early in project planning, prior to the determination of the BSC.

2.4.1 Initial Screening of Alternatives

During initial phases of project formulation, ten alternatives were considered to address the stated purpose and need. The alternatives were compared based on their ability to meet project objectives, minimizes costs and impact to the environment. From this initial screening, three alternatives were retained for detailed consideration. A brief summary of initial screening rationale for each alternative is presented in Table 3 below.

Table 3. Initial Screening of Alternatives

Alt #	Name	Summary Description	Screening Decision/Rationale
1	Raise Top of Dam + Anchoring (100% PMF)	This alternative would allow the dam to safely pass 100% of the PMF through raising the existing non-overflow sections with concrete parapet walls constructed on the existing dam. To address inadequate bedrock foundation and potential for sliding under PMF conditions, the project also includes installation of anchors in the spillway and stilling basin.	The alternative is feasible and would adequately meet project objectives. Screening Decision: Retained.
2	Dam Overtop + Anchoring (100% PMF)	This alternative would allow the dam to safely pass 100% of the PMF through the modification of the existing non-overflow section of the dam to withstand overtopping. Like Alternative 1, anchoring is also included to address inadequate bedrock foundation.	The alternative is feasible and would adequately meet project objectives. Screening Decision: Retained.
3	Construct New Dam (100% PMF)	This alternative would entail construct new dam downstream of existing structure to accommodate 100% of the PMF. The existing dam would be removed.	Cursory consideration of costs and environmental impacts determined that this alternative would provide significantly less net benefits as other alternatives under consideration. Screening decision: Eliminated.
4	Construction Auxiliary Spillway + anchoring	This alternative would allow the dam to safely pass 100% of the PMF through the construction of a second spillway on the left bank of the Tuscarawas River. The spillway would be a channel constructed at the same elevation as the existing	Hydrologic modeling determined that an auxiliary spillway would need to be in excess of 1000 feet wide. Given site conditions, construction of auxiliary

	(100% PMF)	spillway and would allow more water to flow around the dam rather than build up behind the dam. This would lower the PMF elevation and pass most of the impacts downstream. Again, we would anchor the dam to prevent sliding.	spillway would not be economically or environmentally feasible.** Screening decision: Eliminated.
5	Combination of Raise Top of Dam + auxiliary spillway (100% PMF)	This alternative would allow the dam to safely pass 100% of the PMF by a combination of raising the dam and building a second spillway. Under this alternative, the height would be raised but not as much as alternative 1 and a second spillway would be built but it would be smaller than alternative 4. This would hold back some floodwaters and let some go around the dam, thereby balancing the impacts upstream and downstream.	Hydrologic modeling determined that incremental reduction of PMF elevation/parapet wall height required an auxiliary spillway width which would result in significantly greater net costs and environmental impacts than other alternatives under consideration. Screening decision: Eliminated.
6	Anchor Dam Only (<100% PMF)	Under this alternative, the existing dam would be anchored to prevent sliding. No other modifications would take place. This would restore the stability due to inadequate bedrock foundation, but hydrologic deficiencies would persist. If the water level ever reached the top of the dam, it would overtop and likely fail.	This alternative does not address the BSC. Screening decision: Eliminated.
7	Anchor Dam + Auxiliary spillway (<100% PMF)	Would anchor the dam but also provide a second, but smaller spillway. This alternative would provide a little better level of protection than alternative 6. Water flowing through the spillway would essentially lower the elevation of the water behind the dam.	This alternative does not address the BSC. Screening decision: Eliminated.
8	100% PMF Alternatives at smaller scale (<100% PMF)	This alternative would partially implement parts of the previous alternatives. For example, instead of raising the dam to the height of the PMF, we would construct it part way up. Likewise, we might construct a smaller dam downstream that provides some protection but not to the PMF.	This alternative does not address the BSC. Screening decision: Eliminated.
9	Breach Dam	Alternative 9 would remove the dam completely. This alternative is required to be considered by guidance. This alternative would be considered if benefits of correction do not outweigh the cost.	An analysis of benefits vs. costs was prepared. The results indicate the benefits of retaining the dam significantly outweigh the costs. Screening decision: Eliminated.
10	No Action	Alternative 10 is to Do Nothing. For this alternative, no Federal action would be taken in regards to dam safety. For the purposes of hydrologic analysis, this alternative assumes that the upstream dams including Bolivar, Atwood and Leesville would be fully functional during a PMF event.	Although this alternative would not not meet the BSC as required by DSA guidance, it is retained for comparison to action alternatives as part of the NEPA and planning process. Screening decision: Retained.

** An in-depth discussion of auxiliary spillway alternatives is included in Appendix C

2.4.2 Final Array of alternatives

The three alternatives retained for further consideration; No Federal Action, Raise Dam and Dam Overtop, are described in further detail below. Additional technical detail for each alternative can be found in Appendix C.

2.4.2.1 No Federal Action/Do Nothing

Consideration of the "No Federal Action" option is required as one of the alternatives in order to comply with National Environmental Policy Act requirements. The No Federal Action Plan forms the basis against which all other alternative plans are measured. This plan is required by NEPA to be included among the candidate plans in the final array of alternatives.

The No Federal Action Alternative (also referred to as the without project condition) assumes no action by the Federal government to implement any type of modifications to the Dover Dam. The existing economic, social, and environmental conditions and trends in the affected area would persist. The Corps would continue to carefully monitor conditions of the Dover Dam during high water events and make adjustments, as necessary and to the extent possible, to maintain safe pool levels behind the dam.

However, should no action be taken to rehabilitate the dam to meet current standards, the risk of dam failure would persist and increase over time. Moreover, if a large flood event occurs that exceed the Imminent Failure Flood (IFF) condition as described in Section 2.2, the dam is expected to fail, resulting in catastrophic damages and loss of life in downstream areas. Refer to Section 1.8 for an in depth discussion of the consequences of the No Action Alternative.

2.4.2.2 Raise Dam + Anchoring (recommended plan)

This alternative would allow the dam to safely pass 100% of the PMF through raising the existing non-overflow sections with concrete parapet walls constructed on the existing dam. I-walls sections would also be necessary to continue the parapet walls to their termination at high ground (see Exhibit 1). Both parapet walls would be constructed on the upstream side of their respective non-overflow portions of the existing dam. The parapet wall and I-wall combination on the left abutment of the dam would be approximately 240 linear ft. and 140 linear ft. respectively. The proposed parapet wall on the right abutment of the dam would be approximately 130 linear feet. This parapet wall would then adjoin a 170 linear ft. I-wall which would adjoin a 25 ft. gate closure over Ohio Route 800. Average wall height for parapet wall and I-walls would be 8 feet. To address inadequate bedrock foundation and potential for sliding under PMF conditions, the project also includes adding 27 anchors (3 anchors per monolith) to the spillway section of the dam and approximately 130 anchors to the stilling basin.

Review of the original design analysis report for the Dover Dam indicates that there could be deficiencies in the current stilling basin design for spillway discharges. The existing stilling basin may not adequately address downstream erosion during flood events which would overtop the spillway. During floods of this magnitude, downstream erosion feature may enlarge to an extent that would compromise dam integrity. Two measures were explored to address this issue;

a.) Extend existing stilling basin (up to 150 feet downstream) and construct weir at the downstream end to dissipate energy and protect stream bed from erosion.
b.) Construct a concrete cutoff wall at the end of the existing stilling basin to preclude erosion from undermining the existing stilling basin and dam.

Due to significantly greater adverse environmental effects, greater potential for impact to endangered mussel species and technical uncertainties associated with extension of the stilling basin (measure a), the cutoff wall (measure b) was selected to protect the dam from potential erosion during flood events which would overtop the spillway. Furthermore, preliminary cost analysis of the two alternatives showed no significant difference. Environmental effects are described in further detail in Section 2.5.

Access for personnel and construction equipment to the right abutment would be via Ohio Route 800 and other access roads used by project personnel for routine operation and maintenance. However, adequate access to the left abutment construction area is not currently present; therefore, construction of access roads is necessary. Investigation of likely construction equipment to be used for this project determined that a road width of 30 feet would be needed. Three access roads were considered; they are summarized below:

a.) Widen the existing upstream access road to 30 feet. This road runs parallel to the river and is currently used by project personnel for operation and maintenance of the Dam.
b.) Construct a temporary causeway crossing the Tuscarawas River just upstream of the Dam.
c.) Construct an access road utilizing the abandoned railroad grade downstream of the Dam.

Widening the existing upstream access road (access measure a), which is currently 15 ft wide, was eliminated from further consideration. Field studies determined that this would cause significant impact to several streams and several acres of high quality forested wetlands. Moreover, use of this road for hauling material and construction equipment may cause significant impact to several residents and nearby youth camp (Refer to Section 1.6 and 2.6 for detailed discussion of youth camp and potential impacts). However, use of this road for construction personnel would be permitted and may involve minor improvements to the existing gravel road surface. Causeway construction (access measure b) would accommodate all access needed for construction; however, it would create significant risks associated with culvert blockage, increase project costs and would cause significant environmental impact. For these reasons, the temporary causeway was also eliminated from further consideration. Like measure a, the use of the downstream abandoned railroad bed (measure c) would

require widening an additional 15 feet to achieve a total width of 30 feet. Only minor environmental impacts resulting from the removal of adjacent woody and herbaceous vegetation would occur with this haul road alignment (refer to Section 2.6 for detailed discussion of terrestrial impacts). Therefore, the downstream haul road alignment was selected as the preferred access to the left abutment.

Corps studies indicate the Dover Dam is eligible for listing on the National Register of Historic Places and is a significant point of interest along a nationally recognized scenic byway. Several design elements associated with this alternative, including the parapet wall, I-walls and stone slope protection may cause a significant adverse effect on the physical appearance of the dam. Recognizing these resource values, the Corps would incorporate measures, where feasible, to preserve the architectural integrity of the structure. These details would be incorporated during the design phase.

The following measures would be implemented in order to minimize or avoid impacts from the recommended alternative:

- Best Management Practices and good engineering practices would be employed to minimize erosion during construction.
- Cleared and disturbed areas would be revegetated to minimize erosion during construction.
- Upon completion of construction, areas cleared for access and staging would be reestablished with native vegetation to minimize impacts to wildlife and terrestrial habitats.
- All tree clearing would be conducted between September 15th and April 15th to avoid impacts to maternity roost habitat for Indiana Bat. Should clearing need to be conducted outside of that timeframe, the USACE would coordinate with the US FWS and ODNR prior to removal to insure that impacts to Indiana Bats would be avoided.
- Prior to construction, a survey of the stream substrate would be conducted to assess the potential for endangered clubshell mussels. If warranted, a mussel survey would be conducted prior to placement of stone slope protection.
- A ramp compliant with the Americans with Disabilities Act (ADA) would be constructed to provide access to the existing recreational trail impacted by the construction of the I-wall.
- To minimize impacts to traffic, a traffic maintenance plan and construction sequence plan would be prepared prior to construction. These plans would include measures to reduce or avoid impacts to traffic and transportation in the community.
- To avoid potentially significant effects to aesthetic and cultural resources, the modifications to the dam would be designed to be sympathetic to the existing architectural features, to the extent possible while still meeting dam safety standards. The Secretary of Interior's Standards for Rehabilitation would be uses to guide design considerations. Consultation with the SHPO would continue through the design process.
- Prior to construction, a Hazardous, Toxic and Radioactive Waste survey would be conducted for property affected by the proposed action in order to identify sources of potential contamination. Any actions needed to address HTRW concerns would be implemented before construction.

- To avoid or minimize impacts to air quality, all construction would be performed in accordance with the State Implementation Plan, and in compliance with applicable Ohio Environmental Protection Agency Division of Air Quality requirements. The following actions would be noted in the construction specifications to minimize off-site air emissions and air quality impacts associated with construction activities:
    - Cover dump trucks when hauling soil on main highways;
    - Maintain trucks to prevent excess emissions;
    - Shut down heavy equipment when not needed;
    - Use a water or approved chemical spray to suppress dust on roads, materials stockpiles, demolition areas, and other surfaces if required;
    - Utilize silt fences to contain soil in the construction zone;
    - Broom-clean excess soil from heavy equipment and trucks leaving the construction zone to prevent off-site transport;
- Construction workers subjected to high levels of noise would follow standard USACE and OSHA requirements to prevent hearing damage.

2.4.2.3 Dam Overtop + Anchoring

This alternative would allow the dam to safely pass 100% of the PMF through the modification of the existing non-overflow section of the dam to withstand overtopping. High velocity flows over the existing non-overflow sections would require the construction of a concrete sloped spillway and placement of stone slope protection on the downstream side of the left and right abutments. These modifications would direct flows and provide protection from erosion during PMF events (see Exhibit 2). No parapet walls would be constructed with this alternative; however I-walls would be constructed to contain flows to the spillway and existing non-overflow sections.

Like the recommended plan, this alternative also includes adding 27 anchors (3 anchors per monolith) to the spillway section of the dam and approximately 130 anchors to the stilling basin. Like the recommended plan, spillway stilling basin deficiencies would be addressed by the construction of a cutoff wall.

As similar construction equipment would be necessary for the construction of this alternative, this alternative would utilize the same haul roads as the recommended plan.

Adverse effects to ecological resources would be similar to the recommended plan. However, as no parapet walls would be constructed, adverse effect to cultural/aesthetic resources from wall construction would be significantly less than the recommended plan. However, modification of downstream abutments would also adversely affect these cultural/aesthetic resources. Similarly to the recommended plan, the design would incorporate measures, where feasible, to preserve the architectural integrity of the structure.

Measures would be implemented in order to minimize or avoid impacts from the recommended alternative consistent with the recommended alternative.

Table 4 below summarizes economic and environmental considerations of each of the alternatives in the final array.

Table 4. Summary Comparison of Final Alternatives

	No Action	Raise Dam	Dam Overtop
1. Plan Description	Without project condition/no dam modifications	This alternative would allow the dam to safely pass 100% of the PMF through raising the existing non-overflow sections with concrete parapet walls constructed on the existing dam. To address inadequate bedrock foundation and potential for sliding under PMF conditions, the project also includes installation of anchors in the spillway and stilling basin.	This alternative would allow the dam to safely pass 100% of the PMF through the modification of the existing non-overflow section of the dam to withstand overtopping. Like Alternative 1, anchoring is also included to address inadequate bedrock foundation.
2. Economic			
Project cost	$0	$105.7 M	$1141 M
Annual Cost	NA	$ 5.7 M	$6.2 M
Annual O&M	NA	$2 K	$2 K
Annual Benefits	$0	$15.9 M	$15.9 M
F. BCR		$10.2 M	$9.7M
3. Environmental		2.8	2.6
Physiography, Geology and Soils	No impact.	Minor and temporary increase in erosion during construction. BMPs would be used to minimize adverse effects.	Minor and temporary increase in erosion during construction. BMPs would be used to minimize adverse effects.
Terrestrial resources	No impact	Minor impacts from loss of about 2.6 acres riparian forest.	Minor impacts from loss of about 2.8 acres riparian forest.
Wildlife and Endangered Species	No Impact	Potential impacts to endangered mussels and habitat during construction.	Potential impacts to endangered mussels and habitat during construction.
Aquatic Resources	No impact	Minor impacts during construction.	Minor impacts during construction.
Socioeconomic	Significant dam safety hazard continue	Temporary benefit to local economy due to construction. Reduced potential for loss of life and property damages from flooding.	Temporary benefit to local economy due to construction. Reduced potential for loss of life and property damages from flooding.
Recreation Resources	No impact	Temporary closure of recreational areas during construction and permanent obstruction of upstream views from abutment decks.	Temporary closure of recreational areas during construction.
Traffic & Transportation	No impact	Minor impacts during construction.	Minor impacts during construction.
Aesthetics	No impact	Adverse effect from the construction of walls across Route 800 and on abutment decks.	Greater adverse effect from the construction of walls across Route 800 and construction of concrete sloped spillway and placement of stone slope protection on downstream abutment face.
Cultural Resources	No impact	Potential for adverse effect to cultural integrity of dam.	Greater potential for adverse effect to cultural integrity of dam.
HTRW	No impact	Some potential to encounter HTRW	Greater potential to encounter HTRW concerns in the abutment areas.
Air Quality	No impact	Minor and temporary decrease in air quality due to construction activities.	Minor and temporary decrease in air quality due to construction activities.
Noise	No impact	Minor and temporary increase in noise due to construction activities.	Minor and temporary increase in noise due to construction activities.

2.5 **Environmental Consequences**

This Section identifies potential direct and indirect effects of the identified plans on each of the issue areas presented in Section 1.6, and compares and contrasts potential effects of those plans. The potential environmental, cultural, and socioeconomic effects of implementing these plans are identified, as well as their associated mitigation measures, which, when implemented, would reduce the level of identified impacts to acceptable levels.

Due to significant effort to avoid and minimize impacts associated with the action plans, significant impact to all ecological resources was successfully avoided. Significant adverse effect to aesthetic/cultural resources would be minimized or avoided, through the implementation of appropriate mitigation measures during project design. The discussion below documents these considerations for each resource area.

2.5.1 Physiography, geology and soils

Raise Dam (Recommended Plan)

Minor direct impacts to geology and soils would include localized soil disturbance during the construction. Soil disruption in the construction areas, and access roads would temporarily increase erosion in these areas. Disturbance would occur principally at the site of construction activities, access roads, and staging areas.

Modification of the Dam would not directly impact erosion rates. However, larger additional stone slope protection is proposed to protect downstream streambanks from potential erosion from high velocity flows during rare spillway (or higher) flood events.

Good engineering practice and standard erosion control procedures would be implemented to minimize the effects of erosion during construction activities. In addition, cleared and disturbed areas would be seeded to minimize the effects of erosion during construction. Moreover, upon completion of construction, native vegetation would be reestablished in areas cleared for construction access and staging.

Dam Overtop Alternative

Impacts to physiography, geology and soils would be the same as the recommended plan.

No Action Alternative

No construction related impacts to physiography, geology and soils would occur with the No Action Alternative. However, during large flood events that exceed the IFF condition as described in Section 2.2, the dam is expected to fail and the downstream streambanks would remain unprotected from erosion due to high velocity flows.

2.5.2 Terrestrial resources

Raised Dam Alternative (Recommended Alternative)

A total of approximately 2.6 acres of forested land would be cleared with the implementation of this alternative.

Figure 3. Photo of a typical reach of the abandoned railroad which would be used as a haul road for both action alternatives.

Approximately 2.5 acres of young (< 30 years of age) mixed mesophytic upland forest would be impacted due to clearing associated with the widening and improvement of an existing abandoned railroad bed for use as an access road to the left abutment construction area (See figure 3). The proposed access over the abandoned railroad bed would be approximately 7300 ft. The existing clearing associated with the abandoned railroad path is approximately 15 ft. wide; therefore, an additional 15 feet would be needed to achieve an adequate width for construction equipment. Some minor clearing (< 0.1 acre) of bottomland riparian forest would also be necessary for the staging areas.

These impacts are not considered significant; however, upon completion of construction, native vegetation would be reestablished along the road and staging area boundaries to return the area to pre-construction conditions.

Dam Overtop Alternative

A total of approximately 2.8 acres of forested land would be cleared with the implementation of this alternative. This alternative would involve the clearing of approximately 0.2 acre more than the recommended plan.

Clearing associated with this alternative would be slightly larger due to the construction of a concrete spillway and stone slope protection on the downstream side of the non-overflow sections. An additional 0.2 acre section of forested land downstream of the left abutment would be cleared and permanently removed.

Like the recommended plan, these impacts would not be considered significant. However, upon completion of construction, native woody and herbaceous vegetation would be reestablished along the road and staging area boundaries thereby allowing the area to return to pre-construction conditions.

No Action Alternative

No construction related impacts to vegetation would occur with the no action alternative. Existing vegetation along proposed haul routes would continue to mature, providing higher quality habitat in time. Under the No action alternative, dam failure resulting from a PMF event would likely have the greatest potential for downstream flooding and damage from scour.

2.5.3 Wildlife and Endangered Species

Raised Dam Alternative (Recommended Plan)

Terrestrial wildlife within these areas would sustain minor impacts as a result of land clearing and construction of the proposed project. Relatively mobile animals (i.e. deer, birds, and rabbits) would be expected to evacuate the project area during construction activities. These species would be expected to relocate to adjacent undeveloped areas. This could have an impact on adjacent forest communities due to the potential increase of wildlife in those areas. However, this impact would be insignificant because of the relatively small area that would be cleared during construction activities. Moreover, the impacts would be temporary, as the reestablishment of native vegetation in these areas would be implemented as an integral part of the project once construction activities are complete.

Disturbances caused by construction on the project site may affect wildlife in adjacent habitats by disrupting feeding, breeding, and nesting activities. Habitats on and surrounding the site may be used for breeding by migrant and resident songbirds. Increased noise levels created by operation of heavy machinery could cause birds to abandon their nests and may temporarily displace wildlife during construction. Once construction activities are complete, wildlife would likely resume use of the area.

The project also is within the range of three federally listed threatened and endangered species; 1.) Indiana Bat ((*Myotis sodalis*); 2.) Bald Eagle (*Haliaeetus leucocephalus*); 3.) clubshell mussel (*Pleurobema clava*). Potential impacts from the recommended plan are described below.

Cursory field surveys conducted by a biologist from the USFWS concluded that very little, if any, potential Indiana Bat habitat is in the project area (refer to USFWS Planning Aid Letter in Appendix H). However, to avoid any potential impact to the Indiana Bat, all tree clearing activities would be planned within the September 15 and April 15 timeframe, when Indiana bats would not be present. Should the Corps propose clearing outside of this timeframe, the Corps would coordinate with the USFWS and Ohio Department of Natural Resource (ODNR) to ensure the necessary precautions are implemented to avoid impact to the Indiana Bat. Furthermore, habitat lost would be regained through the reestablishment of a native species assemblage upon completion of construction activities.

The project area lies within the range of the bald eagle (*Haliaeetus leucocephalus)*, a Federally-listed threatened species. Coordination with the Ohio Department of Natural

Resources (ODNR) determined that the nearest known nest is approximately 10 miles from the project area. Therefore, no impacts to the bald eagle are anticipated from this project. Therefore, no impact is expected. Prior to construction, the ODNR and USFWS would be consulted to ensure nesting sites that were not previously identified have been located within ½ mile of project activities. If nests are encountered during project construction all activities would cease and proper action and coordination with the USFWS would take place.

The proposed project lies within the range of the clubshell mussel (*Pleurobema clava*), a Federally-listed endangered species. Substrate and flow conditions immediately downstream of the existing stilling basin are favorable for the mussel species. Therefore, at least in theory, portions of this project including streambank protection and construction of the spillway cut-off wall have potential to impact the clubshell mussel. The known distribution of the clubshell mussel and its habits make the presence of individuals proximal to the project unlikely. Nevertheless, the Corps is aware of expanding mussel populations within the system. In agreement with the FWS recommendation in the planning aid letter, stream substrate material in the impacted area will be surveyed prior to construction to assess the potential for clubshell mussel habitat (See Appendix H). If warranted, mussel surveys will be conducted to determine the presence of probable absence of clubshell mussels. Surveys will be scoped and conducted in partnership with the USFWS pursuant to Section 7 of the Endangered Species Act based on detailed project information. Additionally, alternatives to the proposed stone slope protection placement are available and may be employed as design and impact information is developed.

Currently, the feasibility-level details of the project can not support a robust biological assessment or effective feedback from the USFWS. The project details are suitable to demonstrate that impacts are unlikely and that the designer has feasible options available in the event that a biological assessment requires adjustments to the plan during detailed design. The Corps will undertake such analysis as a first action following a USACE decision to pursue detailed design one of the project alternatives. The USFWS have reviewed the proposed project and concur with this approach. Documentation of coordination with the USFWS can be found in Appendix H.

Dam Overtop Alternative

Like the recommended plan, this alternative would also result in minor and temporary impacts to wildlife. However, this alternative would have slightly greater adverse effect on terrestrial habitat (an additional 0.2 acres) than the recommended plan. Therefore, potential impacts to wildlife and endangered species would be slightly higher than that of the recommended plan. The same measures used to minimize and avoid impact to endangered species would be employed with the implementation of this alternative.

No Action Alternative

No construction related impact to wildlife resources would occur with the No Action alternative. However, under the No action alternative, dam failure resulting from a PMF event would likely have the greatest potential for downstream flooding and damage from scour.

2.5.4 Aquatic resources

2.5.4.1 Streams

Raised Dam Alternative (Recommended Plan)

Short term and minor impacts to water quality would occur from erosion during the placement of stone slope protection, installation of anchors, installation of stilling basin cutoff wall and construction of haul routes. These impacts include short term increases in turbidity, as well as reduced light penetration and dissolved oxygen content which can impact aquatic organisms by interfering with feeding, growth and reproduction. These impacts would be minimized through use of Best Management Practices (BMP's). Since the project would not involve fill within waters of the US or impact jurisdictional wetlands, no permit under the Clean Water Act Sec. 401 or 404 would be required. A National Pollution Discharge Elimination System (NPDES) permit would be obtained before construction according to CWA Sec. 402.

Pool retention during PMF events would increase by approximately one foot over the original design condition due to increased height of the non-overflow sections. The PMF is a theoretical storm event and cannot be quantified by flood frequency. However, a recent Corps document, assigns the frequency of such an event to be in the range of 1 in 10,000 years. Due to the infrequency of an event of this magnitude, the stream impacts associated with additional pool retention are considered insignificant.

Dam Overtop Alternative

As this alternative would have the same in-stream structures as the Raised Dam Alternative, it would have the same construction related impacts as that of the recommended plan. Like the recommended plan, these impacts would be minimized through use of Best Management Practices (BMP's). The alternative would also not require Clean Water Act Sec. 401 or 404 permitting, however a CWA Sec. 402 NPDES permit would be obtained prior to construction.

No Action Alternative

No construction related impacts to aquatic resources would occur with the No Action alternative.

2.5.4.2 Wetlands

Adverse effect to wetlands within the project area was avoided (refer to Section 2.5 entitled, "Alternatives"). Therefore, no effect to wetlands would result from either action alternative or the No Action Alternative.

2.5.5 Socioeconomic Resources & Environmental Justice

Direct economic effects would include the creation of a small number of construction jobs during construction of the dam modifications. However, these jobs would only last for the duration of the construction period and would not necessarily be solely within Tuscarawas County. Also, as is typical with large construction projects, local businesses would be expected to experience a slight increase in business during construction.

Construction of the dam modifications would significantly benefit downstream communities through the reduction of flooding risk to downstream residents, businesses, schools, community services and infrastructure.

Neither alternative would cause significant adverse environmental impact to any of the residents in Tuscarawas County. Risks associated with dam failure would be reduced, and flood damage reduction potential would be enhanced providing benefit to all people in flood prone areas of the basin regardless of race, national origin, or level of income. Disproportionately adverse effects to minority of low-income individuals would not occur. Therefore, the Corps has satisfied the requirements of the Environmental Justice Executive Order 12898.

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks, directs federal agencies to "identify and assess environmental health risks and safety risks that may disproportionately affect children." Executive Order 13045 requires federal agencies to "ensure that [their] policies, programs, activities, and standards address disproportionate risks to children" as well. The alternatives for the Dover Dam Safety Assurance Project do not result in environmental health and safety risks to that disproportionately affect children. Therefore, the Corps has satisfied the requirements of Executive Order 13045.

The No Action Alternative would not cause substantial adverse environmental impacts to any of the residents of Tuscarawas County or those affected in the Basin, regardless of race, national origin, or level of income. Dam operations would continue as they currently do and would be consistent with the mandates of Executive Order 12898 and Executive Order 13045.

2.5.6 Recreation

Raised Dam Alternative (Recommended Plan)

Recreation impacts would occur with the construction of the recommended plan. During construction, the day-use recreation area would be temporarily converted to a construction staging area. Due to the relatively minimal use of these areas by the public and substantial number of similarly or better equipped public recreation facilities in nearby areas, recreation impacts to the day-use area are considered insignificant.

Due to safety concerns public viewing decks on both abutments could not be used. The period that construction would limit use of these areas is uncertain, but could be as long as three years.

Implementation of this plan would also limit viewing in these areas (Refer to Section 2.5.7 for detailed discussion of aesthetic resource impacts).

Construction activities would also limit the use of existing recreational trails on the left bank (described in Section 1.6) The duration of this impact is uncertain, but could be as long as three years. However, due to the light public use, and identification of several alternative routes (i.e. Boy Scout Road and Rt. 800) to detour the construction area, the impacts to recreation during construction are considered insignificant. This alternative also proposes an I-wall which would traverse the trail thereby adversely affecting public use of the trail (See Exhibit 1). To mitigate for these effects, an ADA compliant ramp was integrated into project design to facilitate passage over the proposed wall.

Dam Overtop Alternative

Construction related adverse impacts to the day-use area and associated parking would be the same as the recommended plan. However, as no parapet walls would be constructed with this alternative, adverse effect to viewing from abutment deck areas would not be affected (refer to section 2.5.7 for discussion of effects on aesthetic resources).

No Action Alternative

The No Action alternative would result in no construction related impact on recreation resources.

2.5.7 Traffic

Additional traffic on Route 800 and Township Highway 317 would be expected with implementation of both action alternatives. This traffic would consist of trucks, workers' personal vehicles and construction equipment. Debris and soil may deposit on roadways from construction vehicles, creating additional safety hazards as well as annoyance to residents.

A traffic maintenance plan would be prepared by the construction contractor prior to construction, in coordination with local jurisdictions and emergency service providers. Traffic detours, road closings, and other necessary traffic maintenance measures would be prominently posted and also provided to local newspapers in advance. Access would be maintained for residents during construction.

A construction sequencing plan would be prepared by the Corps construction contractor prior to initiation of construction. This plan would include proposed haul routes for soil, rock, and other construction materials. If necessary per the hauling plan, restrictions on hours of hauling would be specified. The plan would be coordinated with local and county government during its development. Any haul route proposed outside of the specified construction work limit would require review and approval by the Corps.

2.5.8 Aesthetic resources

Raise Dam alternative (Recommended Plan)

As previously described in section 1.6, the Dover Dam itself is considered to be a significant aesthetic resource for the area. It is also one of only a small number of large pre-World War II concrete gravity dams in Ohio that have a high level of integrity, and is a good example of the application of the Art Deco architectural style to a 1930s public works project. Moreover, it is eligible for listing in the National Register of Historic Places.

For the general public passing the Dover Dam on Route 800 and utilizing the adjacent viewing area, appreciable changes to the viewscape would occur with the implementation of the preferred alternative (Refer to Exhibit 1). Passing traffic approaching from both directions would observe I-walls and parapet walls averaging 8 feet in height and pass through a gated opening while passing the dam. The walls would also partially or completely obscure views of the river, spillway and upstream face of the dam for public utilizing the parking area and dam abutment viewing deck immediately adjacent to Route 800. The walls on the opposite abutment (left descending bank) would have similar adverse effects, although public use of these areas is minimal.

Views from the day-use recreation area and associated parking located downstream of the dam would not change appreciably due to viewer angle and proposed wall location on the upstream face of the dam. Also, the proposed walls would be partially obscured by the operating house and railings on the downstream side of the platform.

Views of the Dam from upstream viewpoints would be altered. The wall would be contiguous with the upstream face, therefore partially obscuring the operating house and necessitating removal of upstream abutment viewing deck railings. However, because there are no recreation areas upstream, nearly all viewers observing the upstream face are passing traffic on Route 800 and utilizing the trails on the left descending bank. Moreover, existing decorative features from this view are limited.

To minimize effect on aesthetic value of the Dover Dam, the Corps would incorporate measures, where feasible, to preserve and/or be sympathetic to the existing architecture of the structure. These details would be incorporated during the design phase.

Dam Overtop Alternative

Adverse effect to aesthetic resources resulting from construction of I-walls and gate closure for passing traffic would be similar to the preferred alternative. However, no parapet walls would be constructed for this alternative therefore, adverse effect to observation from the abutment viewing decks would not occur with this alternative (Refer to Exhibit 2).

This alternative would result in substantial adverse effect to aesthetic resources in the form of construction of a concrete sloped spillway and placement of 6 foot diameter stone on the downstream side of both abutments. The construction of this spillway and placement of stone would partially obscure and create a visual contrast to some decorative elements on the face of both (left and right descending bank) abutment walls. The alternative would also require the removal and replacement of the existing stairs. These features would significantly alter views from day-use recreation facilities which provide the primary viewing area for the downstream face of the dam.

No Action Alternative

No effect to aesthetic resources would occur with the No Action Alternative. Under the No action alternative, dam failure resulting from a PMF event would likely have the greatest potential for downstream flooding and damage from scour which could impact the aesthetic value of the area.

2.5.9 Cultural Resources

As described in Section 1.6, an archeological reconnaissance of Corps projects in the Muskingum River Basin was conducted in 1981 and 1982. The reconnaissance revealed several archeological sites within Corps property at the Dover Dam. The Corps has engaged in informal consultation with the SHPO, pursuant to the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (NHPA).

The proposed construction area and haul roads for both alternatives are in previously disturbed areas associated with original construction of the Dover Dam and on abandoned railroad beds. Therefore, relatively low potential exists that previously unrecorded archaeological sites would be impacted to by implementation of either action alternative. However, there is still some possibility of discovery of unknown subsurface archaeological resources in the project area. An unanticipated discovery plan will be developed and submitted to the Ohio State Historic Preservation Office (SHPO) prior to construction.

As previously described in section 2.6.7, both action alternatives could have significant effect on the aesthetic/architectural integrity of the structure. However, the Dam Overtop Alternative would have a greater potential for adverse effect by obscuring architectural features of the Dover Dam. The Corps is committed to designing the modifications in such a manner that would be sympathetic to the existing Dover Dam architectural features, to the extent possible, while meeting dam safety standards. As was suggested in discussion with the SHPO, the Secretary of the Interior's Standards for Rehabilitation would be used to guide these design considerations (Department of Interior regulations, 36 CFR 67). The Corps would continue consultation with the SHPO throughout the design phase to ensure full consideration of preservation opportunities and avoid or lessen adverse effect.

No Action Alternative

No effect to Cultural resources would occur with the No Action Alternative. However, under the No action alternative, risk of dam failure would persist. Dam failure would result in significant adverse effects to cultural resources.

2.5.10 Hazardous, Toxic and Radioactive Wastes

Raised Dam Alternative (Recommended Plan)

Prior to construction activities, each property affected by the Proposed Action would undergo a detailed investigation for HTRW and any work necessary to address potential HTRW issues would be addressed prior to construction activities. As per the completed Phase I HTRW Environmental Site Assessments (ESA), this work may include but is not limited to:

- Taking soil samples of the dredge material and soil underneath the dredge material to ensure that no HTRW or other contamination is present in the dredge material that has been applied to the dredge material placement areas.
- Taking samples of the river sediments in the area where the proposed construction is expected to take place due to concerns that sediment in the area around the dam have been impacted by the 1995 Ashland Oil spill which released 300 gallons of crude oil into the Tuscarawas River 15 miles upstream from Dover Dam.
- Soil and groundwater samples taken in the area around the location of the contaminated boring discovered during the 2004 USACE drilling program. This boring revealed potential petroleum contamination located near the dam on the right downstream abutment.
- Toxicity Characteristic Leaching Procedure (TCLP) analysis on railroad ties prior to disposal at the appropriate facility as required by the Ohio EPA and accepting facility.
- Samples for fecal coliform taken to ensure worker safety in the event of excavation near the leach field for vault toilets in the project area.

Due to the accelerated schedule attributable to significance of dam safety concerns, HTRW studies were limited to a Phase I ESA. Should contamination be discovered during the Phase II HTRW ESA, a detailed remediation plan would be developed to guide appropriate disposal of contaminated material. Once detailed information is available regarding the location and extent of contamination, all feasible measures will be taken to avoid these areas. For the purposes of this feasibility study, a worst case scenario of potential contamination was assumed. Conservative remediation costs were generated to support the determination of project feasibility.

Dam Overtop Alternative

Work necessary to investigate potential HTRW contamination would be similar to that of the preferred alternative. However, the Dam Overtop Alternative would be expected to have increase potential for contaminated soil disturbance from construction of a concrete sloped spillway and stone slope protection on the downstream side of the right abutment.

No Action Alternative

The No Federal Action Alternative would result in no impacts associated with HTRW, as the project would not be constructed.

2.5.11 Air Quality

The duration of construction for both action alternatives is projected to last three to four years.

In general, construction activities for both action alternatives would have the potential to cause localized temporary, nuisance air quality impacts. Emission sources include diesel exhaust and fuel odors associated with operation of heavy equipment, engine emissions from personal vehicle use associated with construction, off-site diesel and fugitive dust emissions associated with excavation, earth-moving, and construction activities (including hauling dirt and stone from borrow areas).

There are no residences and establishments nearby the dam or associated staging areas. However, several homes adjacent to proposed access roads would be susceptible to minor and temporary air emission impacts associated with increased construction traffic, particularly if atmospheric and site conditions result in off-site particulate or dust emissions.

All construction would be performed in accordance with the State Implementation Plan, and in compliance with applicable Ohio Environmental Protection Agency Division of Air Quality requirements. The following actions would be noted in the construction specifications to minimize off-site air emissions and air quality impacts associated with construction activities:

- Cover dump trucks when hauling soil on main highways;
- Maintain trucks to prevent excess emissions;
- Shut down heavy equipment when not needed;
- Use a water or approved chemical spray to suppress dust on roads, materials stockpiles, demolition areas, and other surfaces if required;
- Utilize silt fences to contain soil in the construction zone;
- Broom-clean excess soil from heavy equipment and trucks leaving the construction zone to prevent off-site transport;

No Action Alternative

There would be no construction related impact to air quality with the No Action Alternative.

2.5.12 Noise

Construction activities associated with both alternatives are expected to be similar and typical of other comparable construction projects. The sources of noise would be from many activities including mobilization, site preparation, excavation, placing concrete, heavy equipment movement, and installation of the wall components. The most prevalent noise source at construction site is the internal combustion engines on many pieces of equipment which may include, but is not limited to excavators; roller compactors; front-end loaders; bulldozers; graders; backhoes; dump trucks; water trucks; concrete trucks; pump trucks; utility trucks; cranes; sheet pile drivers; man lifts; forklifts; and lube, oil, and fuel trucks.

Actual peak noise levels and associated vibration would vary at a given location based on line of sight, topography, vegetation, and atmospheric conditions. Relatively high peak noise levels in the range of 93-108 dBA may occur on the active construction sites and would decrease with distance from the construction areas. Construction workers who would be subjected to the highest noise levels would follow standard USACE and Federal Occupational Safety and Health Administration (OSHA) requirements to prevent hearing damage. **Table 5** presents peak noise levels that could be expected from a range of construction equipment during proposed construction activities.

Table 5. Peak Noise Levels (dBA, attenuated) Expected from Typical Construction Equipment

Source	Peak Noise Level (dBA)							
	Distance from Source (feet)							
	0	**50**	**100**	**200**	**400**	**1,000**	**1,700**	**2,500**
Heavy Truck	95	84-89	78-93	72-77	66-71	58-63	54-59	50-55
Dump Truck	108	88	82	76	70	62	58	54
Concrete Mixer	108	85	79	73	67	59	55	51
Jack-hammer	108	88	82	76	70	62	58	54
Scraper	93	80-89	74-82	68-77	60-71	54-63	50-59	46-55
Bulldozer	107	87-102	81-96	75-90	69-84	61-76	57-72	53-68
Generator	96	76	70	64	58	50	46	42
Crane	104	75-88	69-82	63-76	55-70	49-62	45-48	41-54
Loader	104	73-86	67-80	61-74	55-68	47-60	43-56	39-52
Grader	108	88-91	82-85	76-79	70-73	62-65	58-61	54-57
Pile driver	105	95	89	83	77	69	65	61
Forklift	100	95	89	83	77	69	65	61

Worst-Case Combined Peak Noise Level (Bulldozer, Jackhammer, Scraper)					
	Distance from Source (feet)				
	50	**100**	**200**	**¼ Mile**	**½ Mile**
Combined Peak Noise Level	103	97	91	74	68

Source: USACE, 2003

Generally speaking, peak noise levels within 50 feet of active construction areas would most likely be considered “striking” or “very loud”, comparable to peak crowd noise at an indoor sports arena (USACE 2003). At approximately 200 feet, peak noise levels would be loud, approximately comparable to a garbage disposal or vacuum cleaner at 10 feet.

The closest receiver to the construction area is a resident and is located approximately ¼ of a miles from the proposed construction area. Due to substantial distance from receivers, intermittent nature of noises and additional buffering from the rolling topography and vegetation, noise the impacts of both action alternatives would be insignificant.

Several residences are located within 300 feet of proposed haul routes. These residences would experience higher noise levels during the day-time hours as personnel, construction equipment and trucks hauling material would travel to and from the construction site. The noise impacts to these areas are temporary and would cease upon completion of construction. The elevation in noise levels from construction traffic is expected to be highly intermittent and would not be considered significant.

2.5.13 Health and Safety

The construction of either action alternative would result in significant benefit to public health and safety through the reduction of potential for dam failure and flooding such as would occur during a PMF event. Health and Safety consequences in terms of population at risk and potential loss of life are further described in Sections 1.8.3 and 1.8.4.

Minor, temporary safety risks associated with construction would include noise and air emissions, construction traffic. These considerations are addressed in other sections.

Continued health and safety risk associated with dam failure would persist and increase over time with implementation of the No Action alternative. Moreover, if a large flood event occurs that exceed the Imminent Failure Flood (IFF) condition as described in Section 2.2, the dam is expected to fail, resulting in catastrophic damages and loss of life in downstream areas.

2.5.14 Cumulative Impacts

Cumulative effects are "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 CFR 1508.7).

The essential components of the cumulative effects assessment are determinations of 1) whether valued resources affected by the project are threatened by activities other than the proposed federal action; 2) whether others plan actions that affect the same component; 3) whether the valued component is "robust" in its ability to sustain impacts; 4) the additive/synergistic affects of the various actions upon the component given its sustainability; and 5)whether modifications to the proposed action are in order in light of these cumulative impacts.

Initial scoping for cumulative effects was undertaken as part of the overall impact assessment. The issue was discussed at both an agency meeting and a public meeting at the onset of the project. At that time, resources of concern and other proposed projects with the geographical limits of Dover were discussed. Certain resources were recognized as potential cumulative impact issues. These included the aquatic ecological (including Endangered Species) and cultural components.

Scoping level analysis determined small potential for cumulative effects to aquatic resources. Since impacts to this resource are limited to temporary, construction-related impacts, the geographic extent for looking at cumulative effects is fairly localized. Temporally, since aquatic resources have historically been degraded and have recently improved, this analysis will also be considered within a relatively short period.

Cursory analysis of development trends in the watershed indicate that development related stressors found in the past and foreseeable future are similar. Specific projects with potential to affect this resource are all fairly minor in nature. A Rail-to-Trail is planned for the rail right-of-way that runs along the left descending bank. Minor road maintenance and agricultural activity within the upper basin could contribute non-source pollution to the river. The demographics

within that portion of the county does not indicate a growing population that would bring with it home building and retail development. Conversely, with the presence of increasing environmental regulation and scrutiny on future watershed development activities, the analysis anticipates additional regulatory control over the minimal development related impacts that might occur.

As described in previous sections, physical habitat, species composition and community structure of macroinvertebrates and fish indicate favorable and/or improving biological conditions. The aquatic ecological resource conditions are expected to continue to improve over time; becoming more robust and sustainable. The input of temporary pulses of turbidity associated with the DSA project are not exceptional in this system and are not expected to measurably contribute cumulatively to the current upward resource trends. Further, as stated in the previous sections, the known distribution of the clubshell mussel and its habits make the presence of individuals proximal to the project unlikely at this time. Impacts from project induced turbidity are not expected to negatively impact substrate quality or water quality except very temporarily. The recolonization process is therefore not expected to be impacted. However, as detailed construction methods and impact assessments are undertaken, the Corps will survey the impact zone for the presence of the clubshell and the potential for future colonization. Alternatives to the proposed bank protection methods are available and may be employed as design and impact information is developed to avoid direct impact to the species. These impacts do not affect the feasibility of the current alternatives.

Concerning cultural resources, the geographic extent of the analysis was considered the state of Ohio and the temporal extent was from 1930, when this style of dam was constructed, to approximately 2050, when the useful life of the dam is over. The Dover Dam was found to be the most intact example of concrete gravity dams of the 1930's era within Ohio. Locally, the dam is the only one displaying the scale, prominence, Art Deco/Neoclassical Revival style among the 14 pre-1950 Muskingum Basin Dams. Details of this assessment are available in the National Register Assessment of Dover Dam, 2006 found in Appendix H.

Since this is a dynamic, working structure, it is important to acknowledge the need to modify this dam to protect life and property downstream. Coordination with the State Historic Protection Office will be maintained throughout the design process to assure all modifications will be done using the Secretary of Interior's Standards. Impacts were mitigated through minimization since avoidance was not deemed an option. The Corps also maintains excellent records of the original structure for future research. The project itself will better assure the sustainability of the structure by assuring its survival of major storm events.

Impacts to aesthetic/cultural resource value of the Dover Dam may occur with the implementation of either action alternative. The District has considered these factors and limited impacts to the viewable structure to relatively low impact features on the upstream face only. Section 2.5.8 and 2.5.9 may be referenced for further details on the impact mitigation approach. To offset the significant cumulative effects, dam safety assurance features preserve downstream existing architectural features of Dover Dam. Therefore, with these avoidance measures in place, the project is not expected to contribute significantly to cumulative impacts to cultural/aesthetic resources in the region. Should additional features be considered during the

design phase which would adversely affect architectural features of the downstream face, an in-depth analysis of cumulative effects would be conducted.

2.5.15 Unavoidable Adverse Impacts

Both of the structural Alternatives would have some unavoidable adverse impacts. Anticipated impacts are discussed below:

- As discussed in Section 2.5.7 and 2.5.8, lasting unavoidable adverse impacts could occur to the aesthetic/cultural resource value of the Dover Dam with the implementation of either alternative. However, during project design the Corps will consider measures to preserve the aesthetic/cultural value of the dam, to the extent possible, while meeting dam safety requirements.
- Noise and air emissions associated with construction would occur. These impacts would be minor and temporary in nature, and BMPs would be used to minimize their severity.
- Short-term adverse impacts would occur to the aquatic habitat during construction. BMPs would be used to limit erosion and sedimentation from construction activities.
- Short-term loss of some terrestrial habitat associated with the downstream haul road. Each alternative footprint and CWL was refined to minimize the amount of impact necessary and native vegetation would be reestablished upon completion of construction activities.

2.5.16 Irreversible and Irretrievable Commitments of Resources

This section describes the major irreversible and irretrievable commitments of resources associated with either alternative. A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations.

The primary irretrievable commitment of resources associated with either alternative is the consumption of fossil fuels (gasoline, diesel, hydraulic fluid) by construction equipment, and to a much lesser extent, consumption of fossil fuels by maintenance equipment during operation.

Similarly, concrete and steel would be required for the walls and anchors. However, at the end of its useful life, these materials could be recycled. The stone used for stone slope protection and spillway has an indefinite useful life, however for the purposes of this analysis it would be irreversibly committed to this project.

2.5.17 Relationship between Short-Term Use of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Because only minor adverse effect on environmental resources would be caused by construction of either alternative, there would be no long-term loss of ecological habitat and associated productivity in the area affected by the proposed project.

3 Recommended Plan

3.1 **Rationale for Recommended Plan**

The final screening and selection of the recommended plan is based on an assessment of the alternatives' ability to meet project objectives, economic impacts (costs and benefits), and environmental impacts.

The **Raise Dam** alternative was chosen as the recommended plan because it more reliably meets project objectives, minimizes costs, and has the least adverse environmental effects.

Reliability of the Dam Overtop Alternative is uncertain due to potential risks associated with existing non-overflow areas and their tolerance to high velocity flows which would occur during a PMF event. The Dam Overtop alternative satisfactorily address downstream abutment scour but does not address forces associated with flow in these areas. Therefore, best engineering judgment concludes that the raise Dam alternative is more reliable.

The Raise Dam alternative minimizes adverse environmental effect. Though ecological impacts were similar for both alternatives; greater adverse effect to cultural and aesthetic resources would result with the Dam Overtop Alternative (refer to Section 2.5).

3.2 **Schedule of Funding**

Funding to date has been utilized for drilling and testing of foundation bedrock for use in sliding stability analysis, for stability analysis and for preparation of the Dam Safety Assurance Program Evaluation Report and EIS. In fiscal year 2003 (FY 03), approximately $76,500 was utilized from the Operation and Maintenance (O&M) appropriation. In FY 04, approximately $93,300 was utilized from the O&M appropriation. In FY 05, approximately $30,600 was utilized from the O&M appropriation. In FY06, approximately $46,900 was utilized from the O&M appropriation and approximately $484,500 was utilized from the Construction General (CG) appropriation. In FY 07, through February 2007, approximately $278,600 was utilized from the CG appropriation. The estimated balance to complete the Dam Safety Assurance Program Evaluation Report and EIS is $30,900, which will be expended in FY 07 and will be CG funds. The total funding to be utilized in FY07, for completion of the Evaluation Report, will be approximately $309,500 from the CG appropriation ($109,500 carryover from FY06 and $200,000 from FY 07). The total project funding needed in future fiscal years (fully funded, which considers inflation) is as follows: In FY 08 the funding need is anticipated to be $8,235,500, in FY 09 the funding need is anticipated to $7,010,600, in FY 10 the funding need is anticipated to be $20,960,400 (construction start), in FY 11 the funding need is anticipated to be $34,722,200, in FY 12 the funding need is anticipated to be $33,422,600, and in FY 13 the

funding need is anticipated to be $1,719,400, bringing the total project cost (fully funded) to approximately $109,060,400.

3.3 **Cost Sharing Requirements**

In accordance with an agreement to partner in implementing the projects in the Muskingum River Basin, also known as "the 1934 Agreement", the Muskingum Watershed Conservancy District (MWCD) originally contributed $12,500,000 of the total cost of $34,590,000 for all dams in the Muskingum Basin (36 %). The Rivers and Harbors Act of 1938 directed the Secretary of War to reimburse the MWCD $4,500,000 reducing their cost share to $8,000,000 or 23 %. In accordance with § 1203 of the Water Resources Development Act of 1986 (WRDA '86), the non-federal cost share is 15% of the cost in accordance with the cost sharing in effect at the time of original construction. More simply stated, the non-federal cost share is 15% of 23%, or 3.45%. The non-federal cost share is 3.45% of the total project cost.

3.4 **Local Cooperation/Public Involvement**

The U.S. Army Corps of Engineers (USACE) conducts bi-annual partnering meetings with the Muskingum Watershed Conservancy District (MWCD). In 2006, the partnering meetings occurred on 17 May and 12 October. During these meetings, the schedule for implementation of the Dover Dam Safety Assurance project was discussed. An estimate for the project cost was also presented to the MWCD. The MWCD has verbally agreed to be the non-federal cost-share partner, subject to approval of an assessment. The USACE, Huntington District, currently has a partnering agreement with the MWCD. The USACE also has an agreement with the MWCD, known as "the 1934 Agreement". Both agreements are located in Appendix B of this report. Prior to acquisition of real estate, a Project Cooperation Agreement (PCA) will be executed between the USACE and the non-federal sponsor. The PCA will state the responsibilities of both parties, including the federal and non-federal cost share of the project.

Public participation is a significant component of the Corps planning process. The USACE considers public comments before making a decision. A Notice of Intent (NOI) to prepare an Environmental Impact Statement was given to the public and was published by the USACE in the *Federal Register* on May 5, 2006, thereby initiating a 60-day comment period on the proposed actions. The notice also announced the date and location of the public scoping meeting, with additional notification made through advertisements in the New Philadelphia Times-Reporter, the Massillon Independent and the Canton Repository. A press release was also sent out a week before the meeting to the local media.

The public meeting was conducted on 6 April 2006 in New Philadelphia, OH at the MacDonald-Marlite Conference Center. During this meeting, the public was presented the current condition of the Dover Dam. Also, two additional scoping meetings were held in order to provide further opportunity for public and agency comments on the proposed actions. The meetings were also held at the McDonald/Marlite Conference Center in New Philadelphia, OH on May 24, 2006. The resource agency meeting was conducted during the afternoon and a public meeting in the evening. The presentation at these meetings focused on the current condition of the dam and the list of preliminary alternatives that have been developed to address known deficiencies. Approximately 30 persons attended the scoping meetings. Comments received during the

scoping process have also been included in Appendix J. The EIS placed increased focus on those issues brought forth during scoping.

A final public meeting was conducted on January 18, 2006 at the McDonald/Marlite Conference Center in New Philadelphia, OH. The purpose of the final public meeting was 1.) to present information about the proposed project and the DEIS and 2) to obtain comments and concerns from the public about the project and DEIS. The meeting included a formal presentation by Corps staff followed by a formal comment period.

The public and agency comment period for the DEIS closed on March 12, 2007. Approximately 15 comments were received. Comments received were in the form of federal and state agency responses, individual letters, public meeting comment sheets, and public meeting statements. All comments received were fully considered. Appendix J includes all comments received and documents the USACE response and consideration of these comments.

3.4.1 Draft Environmental Impact Statement Distribution List

The DEIS was circulated to the following agencies, officials, organizations and individuals.

Federal Agencies and Elected Officials

United States Senators
Honorable George V. Voinovich
524 Hart Senate Office Building
Washington, DC 20510

Honorable Sherrod Brown
2332 Rayburn Building
Washington, DC 20515

Representatives in Congress
Honorable Zach Space
714 North Wooster Avenue
Dover, OH 44622

US Environmental Protection Agency
Office of Federal Activities
EIS Filing Section
Mail Code 2252-2, Room 7241
Ariel Rios Building (South Oval Lobby)
1200 Pennsylvania Avenue, NW
Washington, DC 20004

EIS Review Coordinator
EPA Region V
77 West Jackson Boulevard
Chicago, IL 60604

Federal Highway Administration
400 Seventh Street, SW
Washington, DC 20590

Advisory Council on Historic Preservation
1100 Pennsylvania Avenue NW, Suite 809
Old Post Office Building
Washington, DC 20004

US Department of Agriculture
Natural Resources Conservation Service
District Conservationist
New Philadelphia Service Center
277 Canal Avenue
SE, Suite B
New Philadelphia, OH 44663-6902

US Department of Health and Human Services
200 Independence Avenue, SW
Washington, DC 20201

US Department of Housing and Urban Development
451 7th Street SW
Washington, DC 20410

US Department of the Interior
Director, Office of Environmental Policy and Compliance
Main Interior Building,
1849 C Street, N.W.
Washington, DC 20240

US Department of the Interior
Fish and Wildlife Service
Field Supervisor
6950 Americana Parkway
Suite A
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Federal Emergency Management Agency
500 C Street, SW
Washington, DC 20472

State Agencies and Elected Officials

Office of the Governor
Governor Ted Strickland
309 South 4th Street
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Columbus, OH 43215

Ohio Department of Transportation
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Department for Local Government
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8995 East Main Street
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Local Agencies and Elected Officials

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New Philadelphia, OH 44663

Tuscarawas County Emergency Management
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Mayor Richard Homrighausen
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Dover, OH 44622

Mayor Ronald Brodzinski
150 East High Avenue
New Philadelphia, OH 44663

Dover Fire Department
116 E 3rd St
Dover, OH 44622

New Philadelphia Fire Department
108 2nd St SE
New Philadelphia, OH 44663

Tuscarawas County Chamber of Commerce
1323 4th Street NW
New Philadelphia, OH 44663

Organizations and Individuals

Sierra Club
Ohio Chapter Office
36 W. Gay St
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Public Libraries

Tuscarawas County Public Library
121 Fair Avenue NW
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Dover Public Library
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4 List of Preparers

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Appendix A – Authorizing Legislation

Appendix B – Existing Contracts

Appendix C – Engineering Appendix

Appendix D – Project Management Plan

Appendix E – Cost Estimate

Appendix F – Real Estate

Appendix G – Hazardous, Toxic, and Radioactive Waste (HTRW)

Appendix H – Environmental/NEPA

Appendix I – Economics

Appendix J - Public & Agency Comments and Responses